CLAIMS

What is claimed is:

1. A method for reproducing a signal of a desired profile, for use in processing digitally sampled signals in a receiver, the method comprising the steps of:

demodulating received signals in a receiver, to derive a periodic code signal;

generating in the receiver a local clock signal used to provide signal sampling pulses separated by sampling intervals;

determining a frequency difference between the local clock signal and the received signals;

adjusting the local clock signal to compensate for the frequency difference;

deriving from the frequency difference a code phase value that provides a measure of a sub-sample code phase difference between the sampling pulses and the received code signals; and

using the sub-sample code phase difference to reproduce a desired signal that is precisely synchronized with the received code signals.

2. A method as defined in claim 1, wherein the step of using the sub-sample code phase difference includes:

determining a signal magnitude for each of a succession of time values as determined from the occurrence of sampling pulses and the sub-sample code phase difference values; and

outputting a succession of magnitudes to provide the desired signal profile.

3. A method as defined in claim 1, wherein:

the desired signal defines a weighted time window; and

the method further comprises the step of applying the weighted time window to the received signals, to detect a signal event expected to occur within the weighted time window.

4. A method as defined in claim 2, wherein:

the desired signal defines a weighted time window; and

the method further comprises the step of applying the weighted time window to the received signals, to detect a signal event expected to occur within the weighted time window.

5. A method as defined in claim 4, wherein the step of determining a signal magnitude for each of a succession of time values provides a time window that is weighted to optimize signal event detection for a particular communication channel through which the signals are received.

6. A method for generating a desired signal that is synchronized with respect to a signal event in a received, periodic, digitally sampled signal, the method comprising the steps of:

generating sample clock signals at sample intervals occurring at a sampling clock rate that is nominally an integral multiple of a rate at which signal events may occur in a received periodic signal, but which cannot be exactly synchronized with the received periodic signal;

generating sub-sample clock signals;

deriving from the sub-sample clock signals a measure of clock phase within each sample interval; and

generating the desired signal synchronized with the received signal event to an accuracy level limited only by the sub-sample clock signals.

7. A method as defined in claim 6, wherein the step of generating the desired signal includes:

generating a succession of signal magnitudes at times determined by the sub-sample clock signals, to provide a desired signal profile.

8. A method as defined in claim 6, wherein the step of deriving a measure of clock phase includes:

applying the sub-sample clock signals to a counter;

resetting the counter with the sample clock signals; and

using the counter value as the measure of clock phase.

9. A method for generating a weighted signal window of a desired profile in a GPS receiver that digitally samples received periodic signals, the method comprising the steps of:

demodulating received signals in a GPS receiver, to derive a periodic GPS code sequence;

generating in the receiver a local clock signal used to provide signal sampling pulses separated by sampling intervals and to generate other timing signals;

generating in the receiver a local periodic GPS code sequence similar to the one received, at a code rate determined in part by the local clock signal and nominally the same as the received code rate;

determining in the receiver a frequency difference between the received GPS code rate and the locally generated GPS code rate;

applying the frequency difference to the locally generated GPS code rate to provide an adjusted locally generated GPS code rate;

deriving from the frequency difference a code phase value indicative of the code phase within a code rate period; and

using the code phase value to generate a weighted signal window that is synchronized with a desired signal event in the received GPS code sequence.

10. A method as defined in claim 9, wherein:

the step of applying the frequency difference to the locally generated GPS code includes dividing the frequency difference by a selected value, using a counter to provide an output signal whenever the counter overflows, to indicate that the frequency difference has resulted in a cumulative phase error equivalent to a whole code rate period; and

the step of deriving a code phase value includes multiplying the code rate period by the ratio of the current counter contents to a full counter value.

11. A method as defined in claim 10, wherein the step of using the code phase value to generate a weighted signal window includes:

generating a succession of signal values of selected magnitudes, at times precisely determined from the code phase values, wherein the signal window is synchronized with a received signal event and has a desired profile.

12. A method as defined in claim 11, wherein:

the desired window profile is selected to mitigate multipath effects.

13. The method as defined in claim 11, wherein:

the desired window profile is selected for optimal detection of a signal pulse after the received signals have passed through a communication channel of limited bandwidth.

14. In a receiver that processes digitally sampled signals, apparatus for reproducing a signal of a desired profile, the apparatus comprising:

a demodulator connected to receive signals in a receiver, and to derive a periodic code signal;

a local clock signal generator used to provide signal sampling pulses separated by sampling intervals;

a frequency differencing circuit, for determining a frequency difference between the local clock signals and the received signals;

means for adjusting the local clock signal to compensate for the frequency difference;

means for deriving from the frequency difference a code phase value that provides a measure of a sub-sample code phase difference between the sampling pulses and the received code signals; and

a signal generator using the sub-sample code phase difference to reproduce a desired signal that is precisely synchronized with the received code signals.

15. Apparatus as defined in claim 14, wherein the signal generator using the sub-sample code phase difference includes:

means for determining a signal magnitude for each of a succession of time values as determined from the occurrence of sampling pulses and the sub-sample code phase difference values; and

means for outputting a succession of magnitudes to provide the desired signal profile.

16. Apparatus as defined in claim 14, wherein:

the desired signal defines a weighted time window; and

the apparatus further comprises means for applying the weighted time window to the received signals, to detect a signal event expected to occur within the weighted time window.

17. Apparatus as defined in claim 15, wherein:

the desired signal defines a weighted time window; and

the apparatus further comprises means for applying the weighted time window to the received signals, to detect a signal event expected to occur within the weighted time window.

18. Apparatus as defined in claim 17, wherein the means for determining a signal magnitude for each of a succession of time values provides a time window that is weighted to optimize signal event detection for a particular communication channel through which the signals are received.

19. Apparatus for generating a desired signal that is synchronized with respect to a signal event in a received, periodic, digitally sampled signal, the apparatus comprising:

a sample clock signal generator, generating clock signals at sample intervals occurring at a sampling clock rate that is nominally an integral multiple of a rate at which signal events may occur in a received periodic signal, but which cannot be exactly synchronized with the received periodic signal;

a sub-sample clock signal generator;

means for deriving from the sub-sample clock signals a measure of clock phase within each sample interval; and

means for generating the desired signal synchronized with the received signal event to an accuracy level limited only by the sub-sample clock signals.

20. Apparatus as defined in claim 19, wherein the means for generating the desired signal includes:

means for generating a succession of signal magnitudes at times determined by the sub-sample clock signals, to provide a desired signal profile.

21. Apparatus as defined in claim 19, wherein the means for deriving a measure of clock phase includes:

means for applying the sub-sample clock signals to a counter;

means for resetting the counter with the sample clock signals; and

means for using the counter value as the measure of clock phase.

22. Apparatus for generating a weighted signal window of a desired profile in a GPS receiver that digitally samples received periodic signals, the apparatus comprising:

a demodulator, for demodulating received signals in a GPS receiver, to derive a periodic GPS code sequence;

a local clock generator, for generating a local clock signal used to provide signal sampling pulses separated by sampling intervals and to provide other timing signals in the receiver;

a local periodic GPS code generator, for generating in the receiver a local periodic GPS code sequence similar to the one received, at a code rate determined in part by the local clock signal and nominally the same as the received code rate;

a circuit for determining a frequency difference between the received GPS code rate and the locally generated GPS code rate;

an adjustable divider circuit for applying the frequency difference to the locally generated GPS code rate, to provide an adjusted locally generated GPS code rate;

a counter circuit for deriving from the frequency difference a code phase value indicative of the code phase within a code rate period; and

a signal window generator that uses the code phase value as a measure of time, and generates a weighted signal window that is synchronized with a desired signal event in the received GPS code sequence.

23. Apparatus as defined in claim 22, wherein:

the counter circuit for deriving a code phase value divides the frequency difference by a selected value and provides an output signal whenever the counter

overflows, to indicate that the frequency difference has resulted in a cumulative phase error equivalent to a whole code rate period, wherein this output signal is coupled to the adjustable divider circuit; and

the apparatus further comprises a code phase generation circuit, for multiplying the code rate period by the ratio of the current counter contents to a full counter value.

24. Apparatus as defined in claim 23, wherein signal window generator includes:

means for generating a succession of signal values of selected magnitudes, at times precisely determined from the code phase values, wherein the signal window is synchronized with a received signal event and has a desired profile.

25. Apparatus as defined in claim 24, wherein:

the signal window generator provides a desired window profile selected to mitigate multipath effects.

26. Apparatus as defined in claim 24, wherein:

the signal window generator provides a desired window profile selected for optimal detection of a signal pulse after the received signals have passed through a communication channel of limited bandwidth.